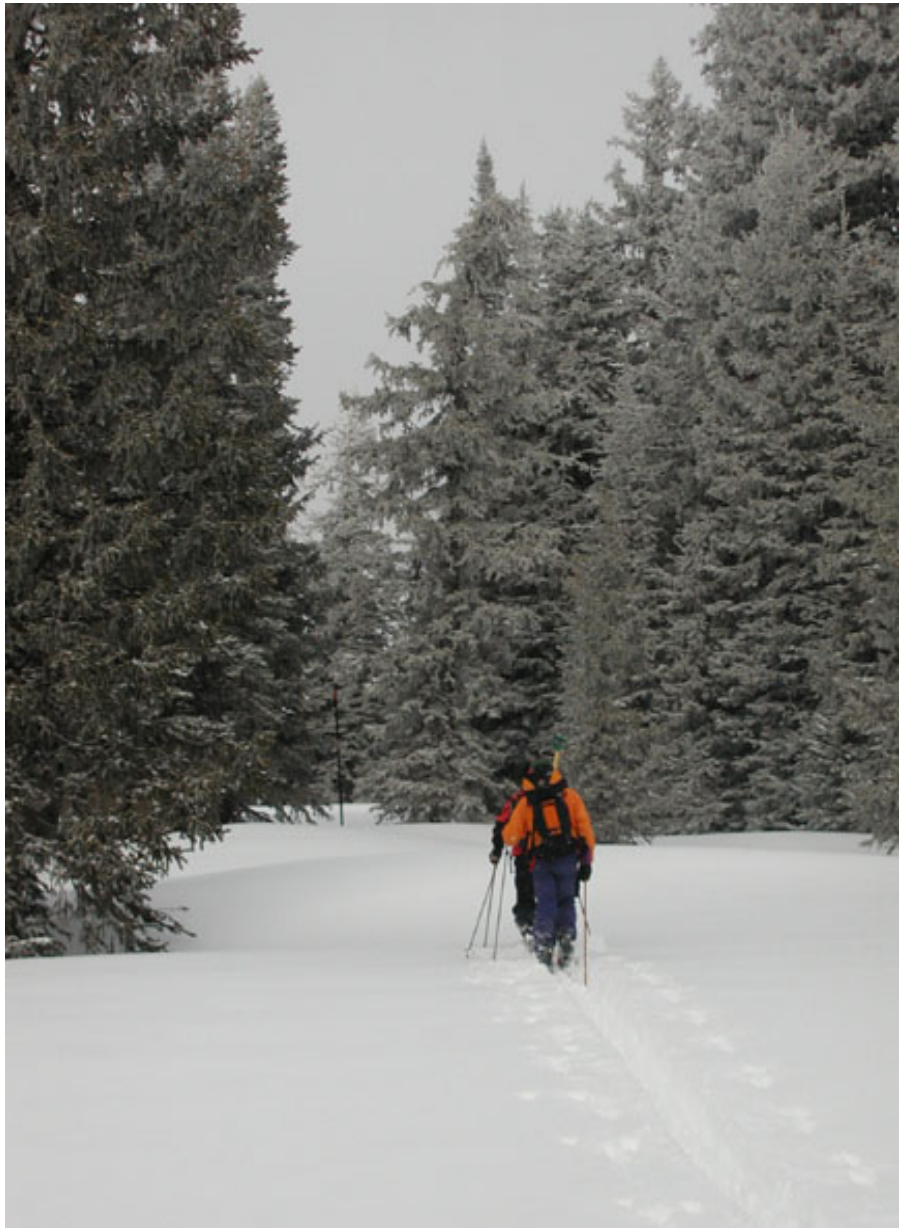

AMSR-E snow algorithm: correcting microwave attenuation from forests (+) in the retrievals

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Outline

- Pre Version 07 approach
- Version 07 approach
- Ongoing Validation
- Plans

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- Hall *et al.* (1982) undertook a study of snow emission in a forested area in Michigan and formulated:

$$T_{AP} = C_f T_{APf} + (1-C_f)T_{APs} \quad [K]$$

Where T_{AP} is the scene Tb, C_f is the fractional area of forest, T_{APf} is the Tb from the forest cover and T_{APs} is the Tb from snow. They assumed that the emissivity of forest (e_f) was 0.9 and obtained the physical temperature of the forest (T_f) from *in situ* measurements such that:

$$T_{APf} = T_f e_f \quad [K]$$

They solved the first expression for T_{APs} and correlated this 'residual Tb' with snow depth (R=0.82)

- Chang *et al.* (1996) and then *Foster et al.* (1997) generalized this approach further such that:

$$SWE = A + B \Delta Tb / (1-f) \quad [mm]$$

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Limitation

Correction of forest moderation effects was generalized; no information was available globally on:

- Forest spatial density
- Forest gap size

In essence, forest attenuation was generalized spatially.

Pathway forward

This is no longer the case as new data sets are being made available with rich information content about forests. Two potential approaches are now becoming possible:

a) correction of the microwave radiometry with a microwave model (e.g. network models)

b) use of moderate to high spatial resolution visible/infra-red global vegetation products to empirically correct

The shoestring approach..... we have been assessing approach b).

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Globally:

1. *Where are the trees?*
2. *How spatially dense or unmixed are the trees in in the forest stands?*
3. *What about low-stand vegetation (shrubs etc)?*

There are some interesting MODIS products that can be used to characterize vegetation globally:

- MOD12 Boston University IGBP land classification
- MOD09 VCF from University of MD GLCF

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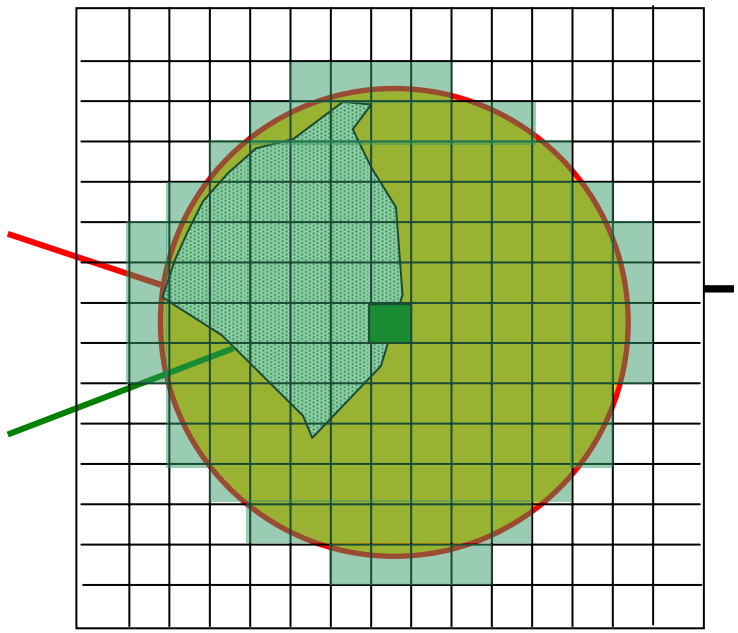
How should we perform the correction?

- Correct at the individual IFOV footprint scale (not the gridded product scale)
- What is the average forest cover and spatial density in a 7.5 km radius ?
- Project the result to a 1 x 1 km grid – work at the MODIS grid scale
- For each AMSR-E sample, find the 1 km forest grid cell that coincides with the centre of sample and use the relevant data to make the correction



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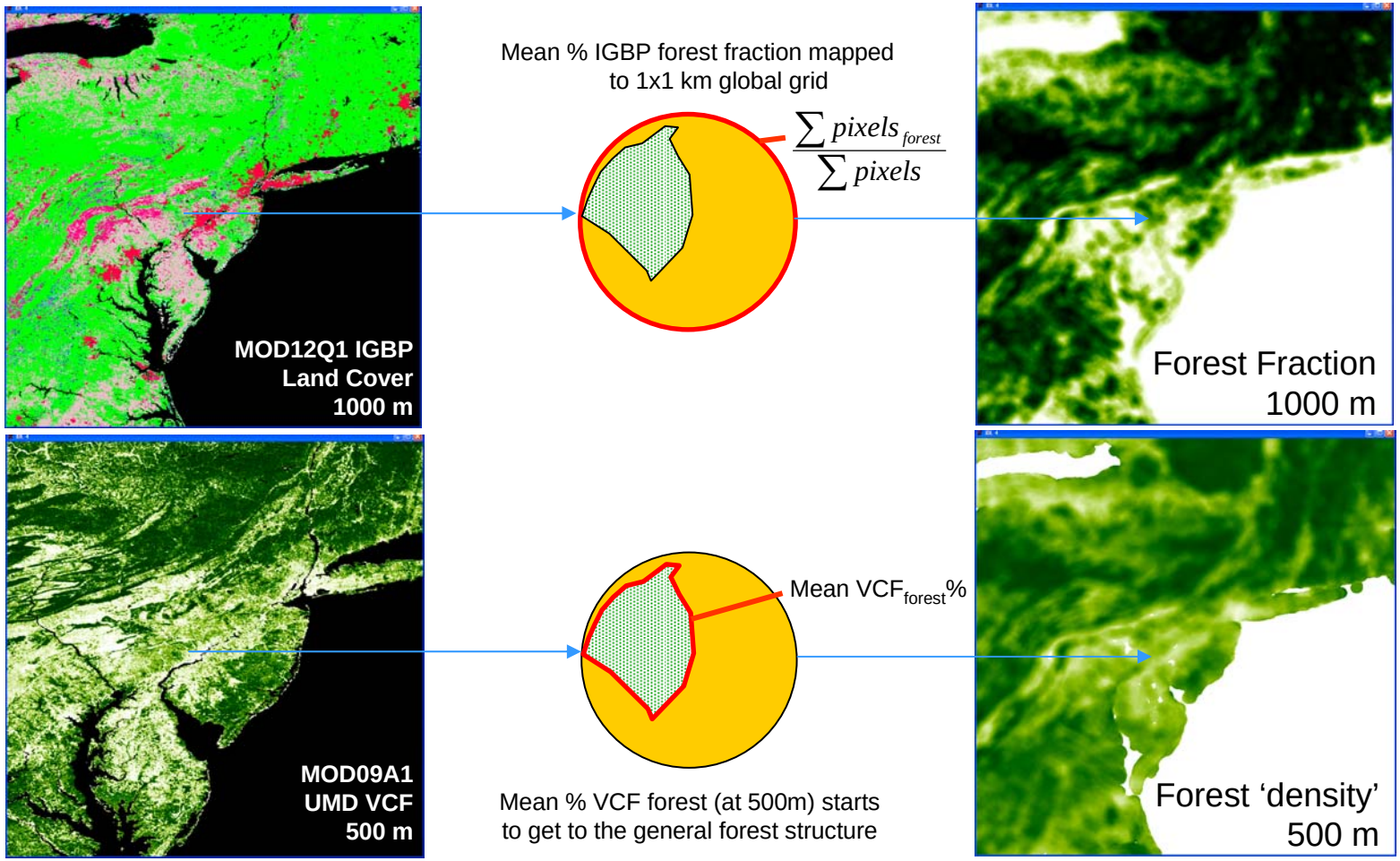
Forest cover definition (1 x1 km cell grid ~1Gb global)

…. Or, how AMSR-E might see the forests



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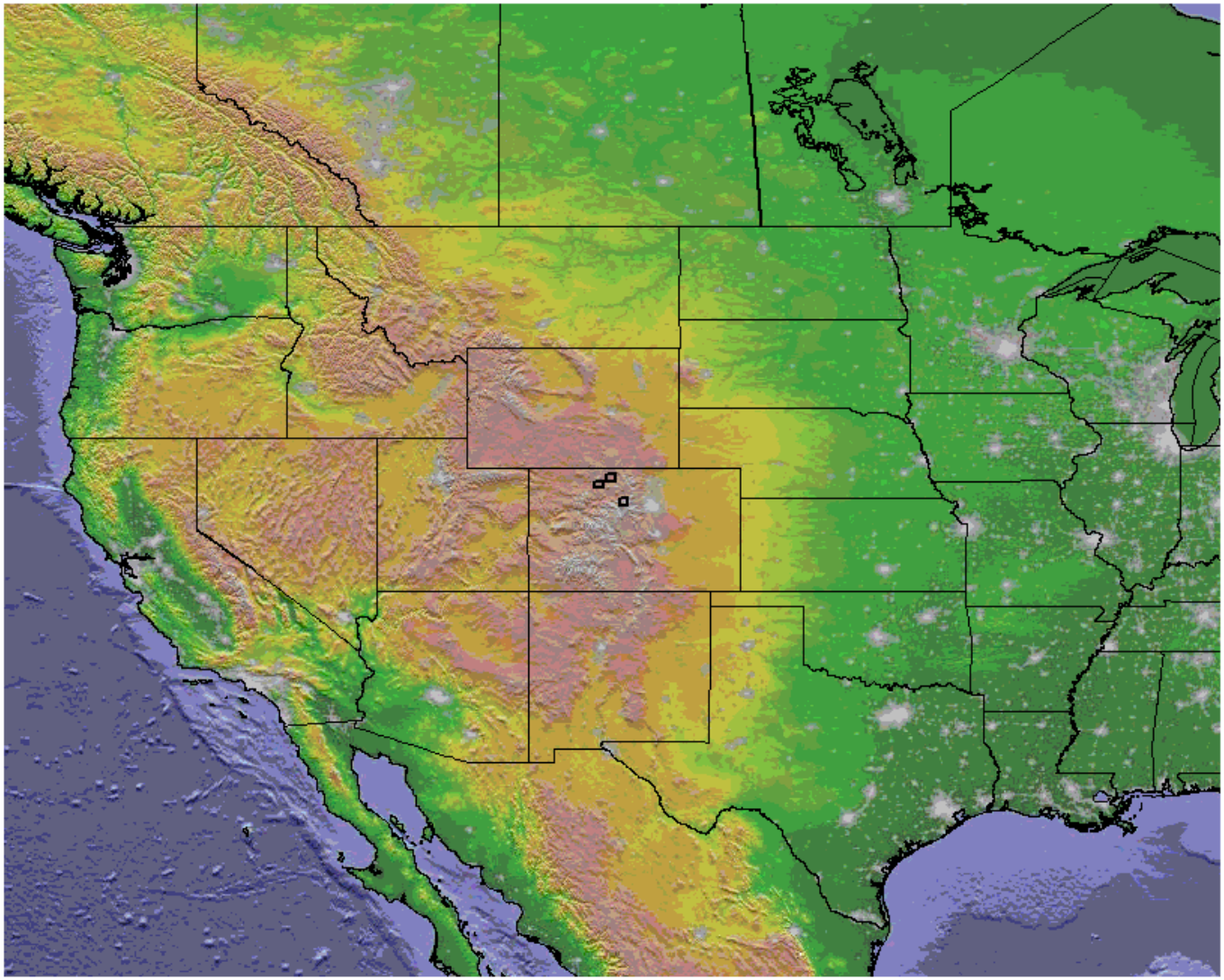
Local example: CLPX



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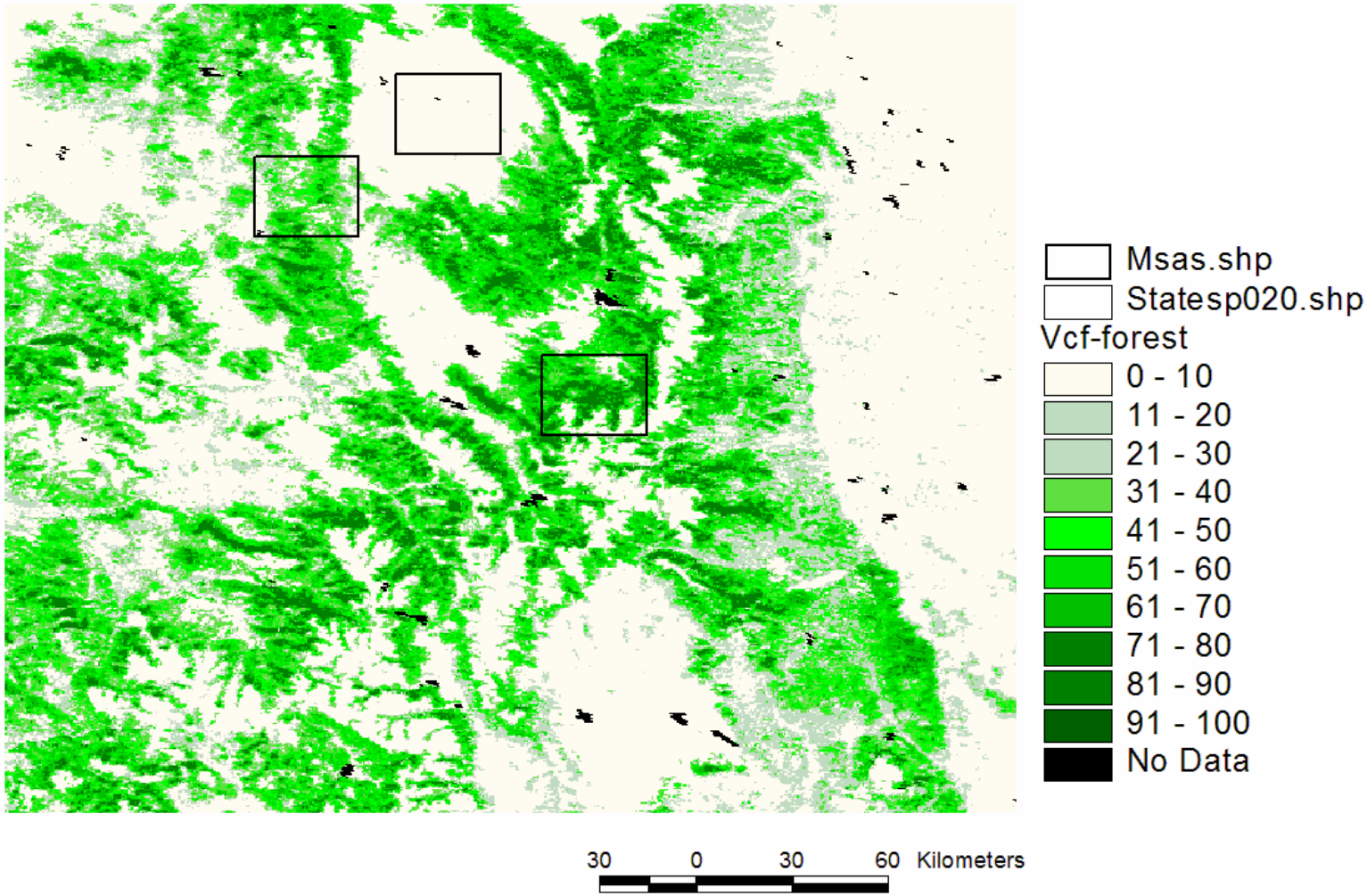

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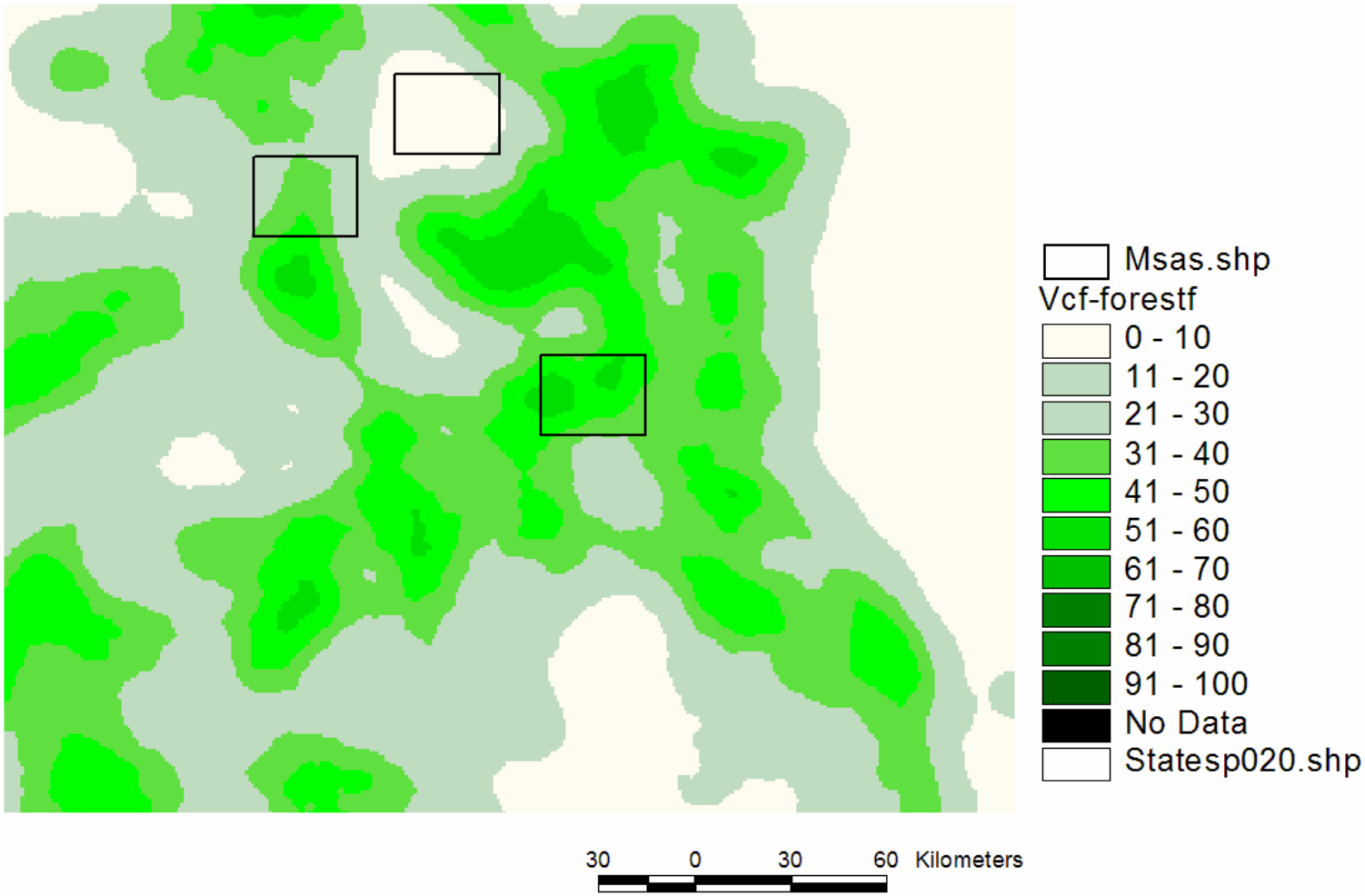

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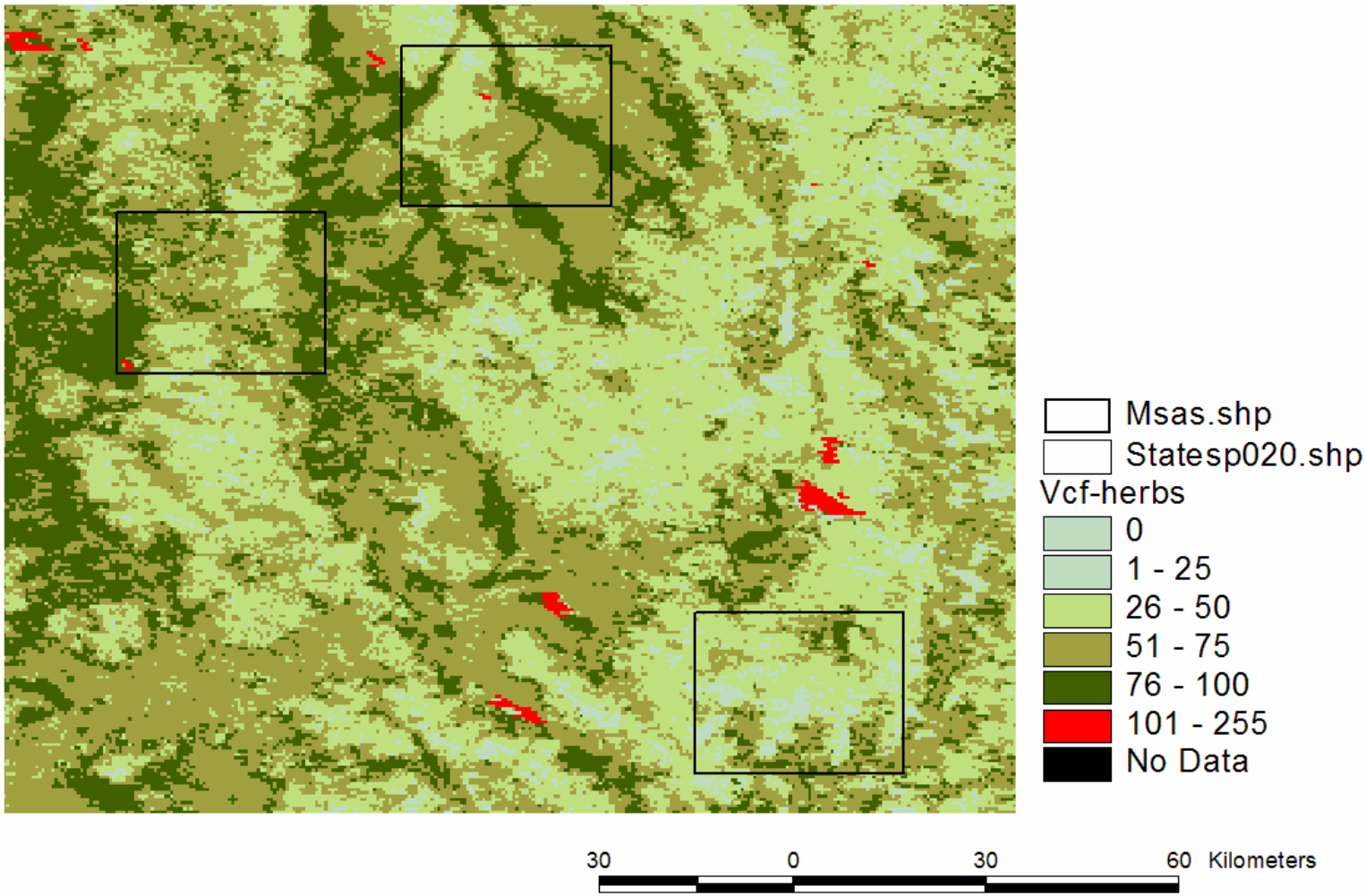
Herbaceous cover from VCF data



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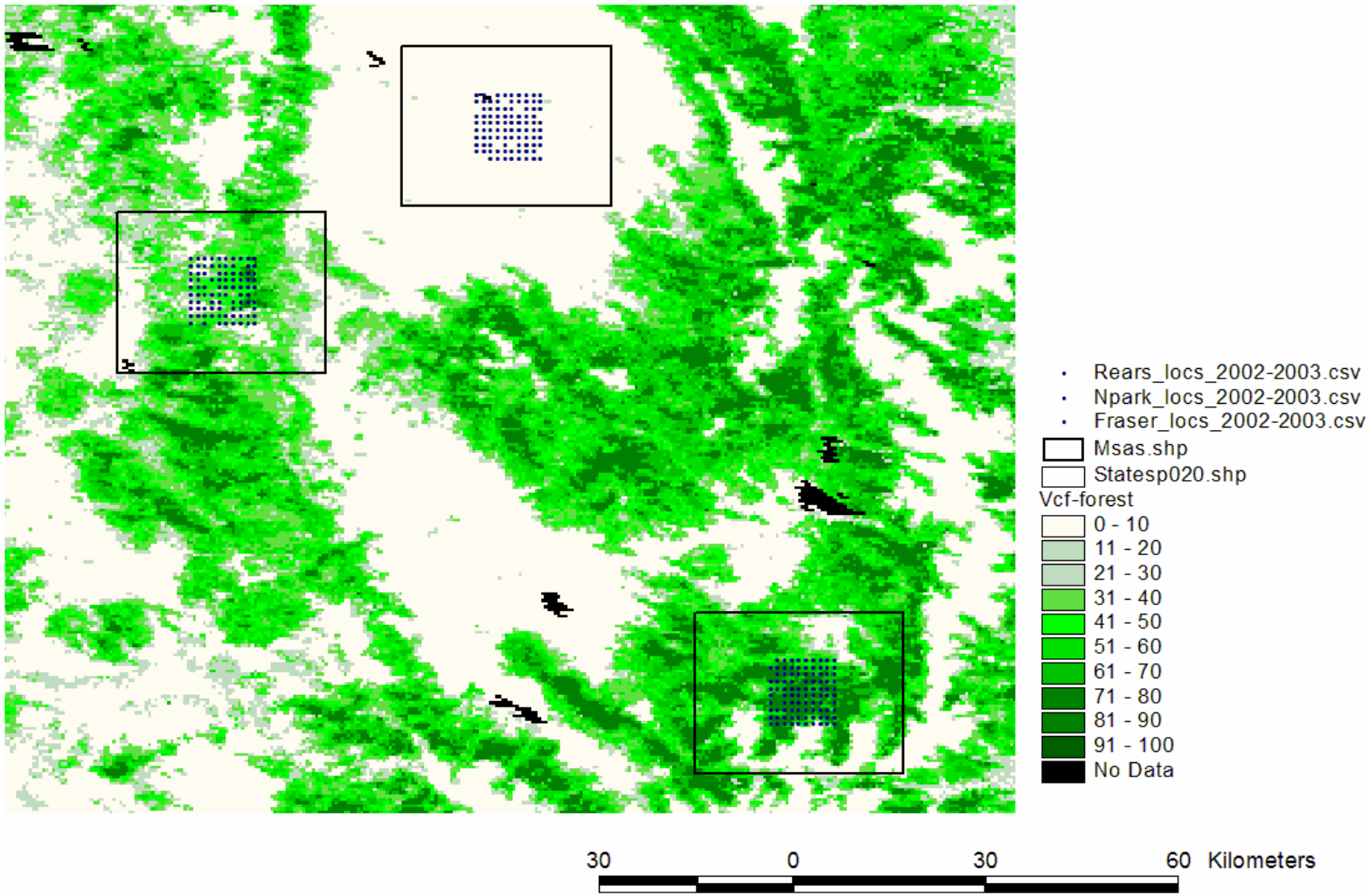
AMSR-E data

Collected data within 0.07 degrees radius of MSA centres



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Simplified approach that incorporates dynamic microwave response behaviour:

$$SD = FF(SDf) + (1-FF)(SDo)$$

$$SD = FF * \frac{(A*(18V-36V))}{[1-(FD+FH)]} + (1-FF)* [(A*(10V-36V)) + (B*(10V-18V))]cm$$

Forest

Non-forest Medium snow

Non-forest Deep snow

0.6 replaced with Fraction of Herbaceous (FH)

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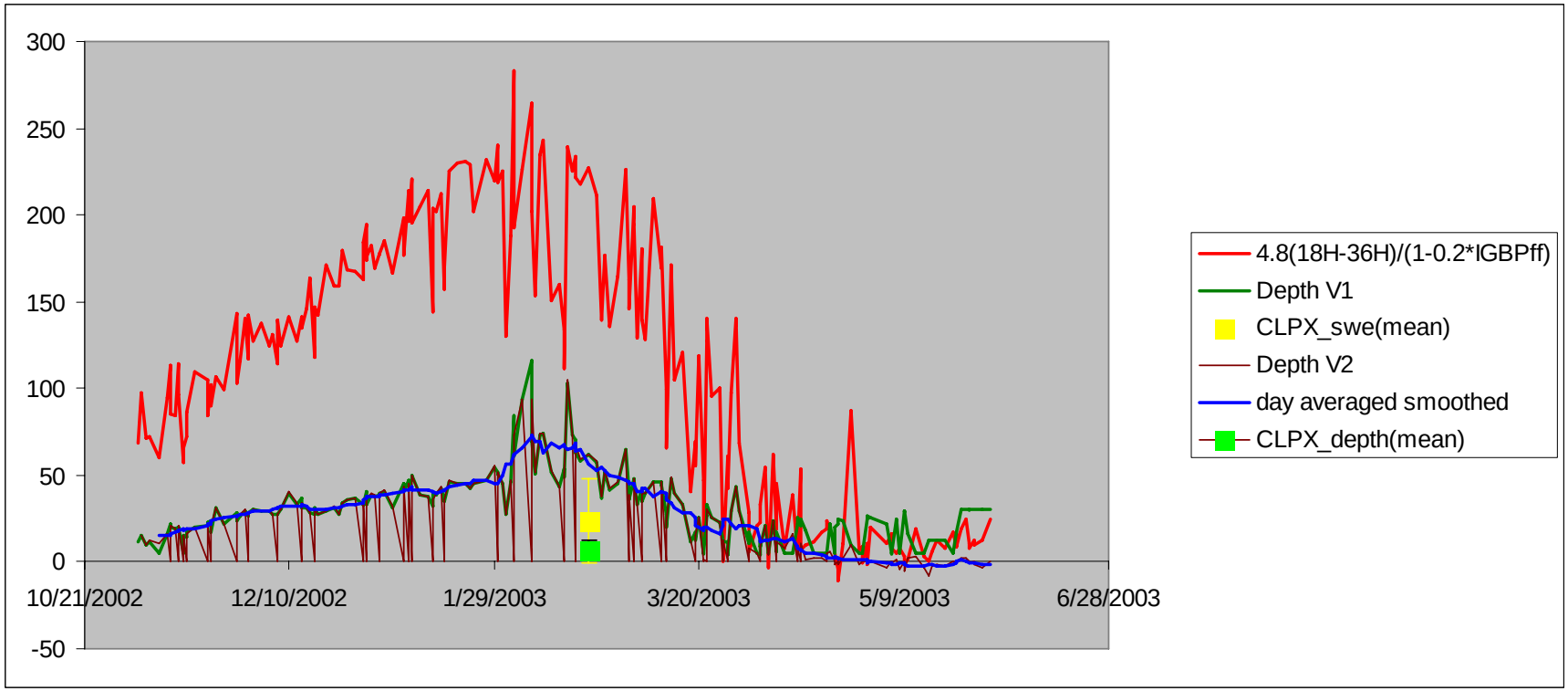
North Park

Sparse Forest Fraction.



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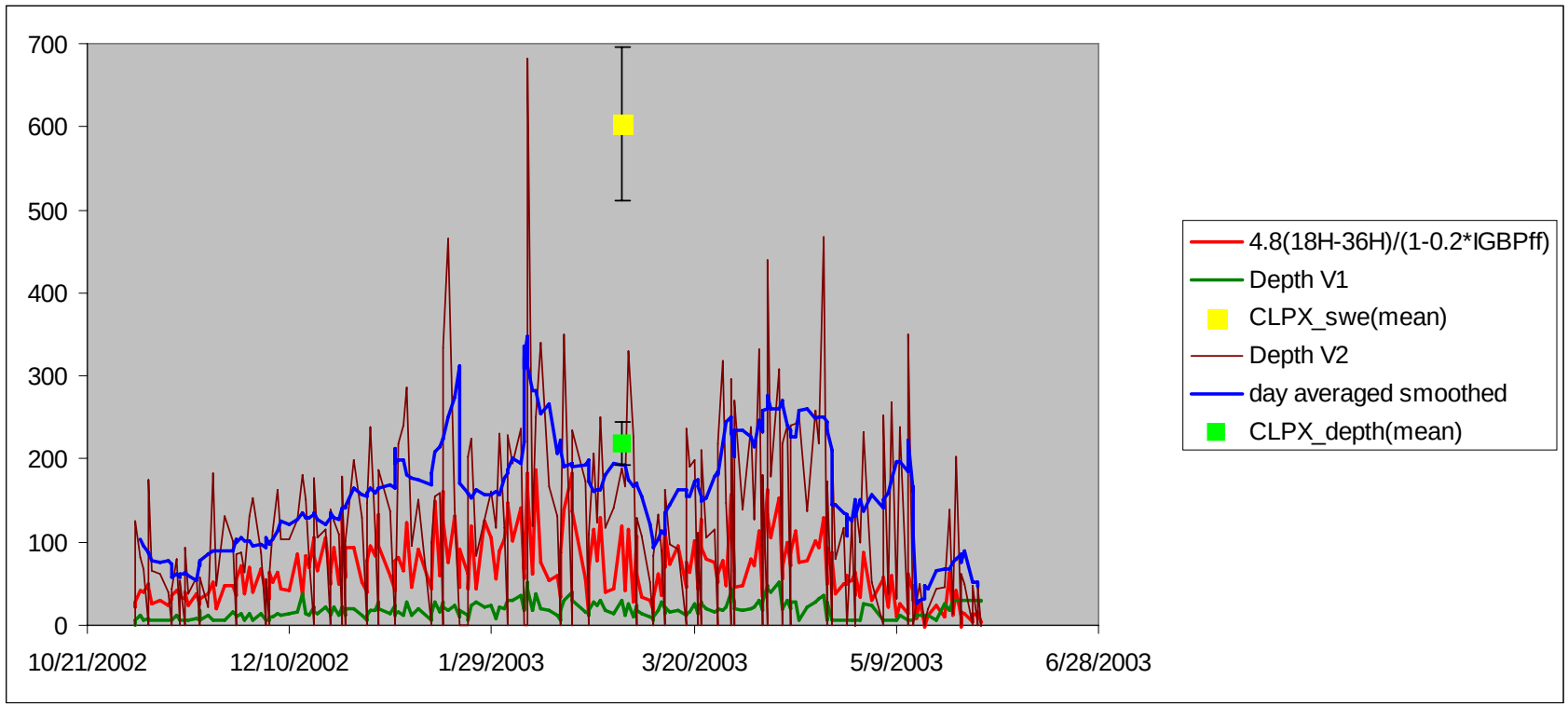
Rabbit Ears

Moderate forest fraction (IGBP ~ 0.5) and not dense (VCF ~ 0.35)

Herbaceous fraction ~0.39



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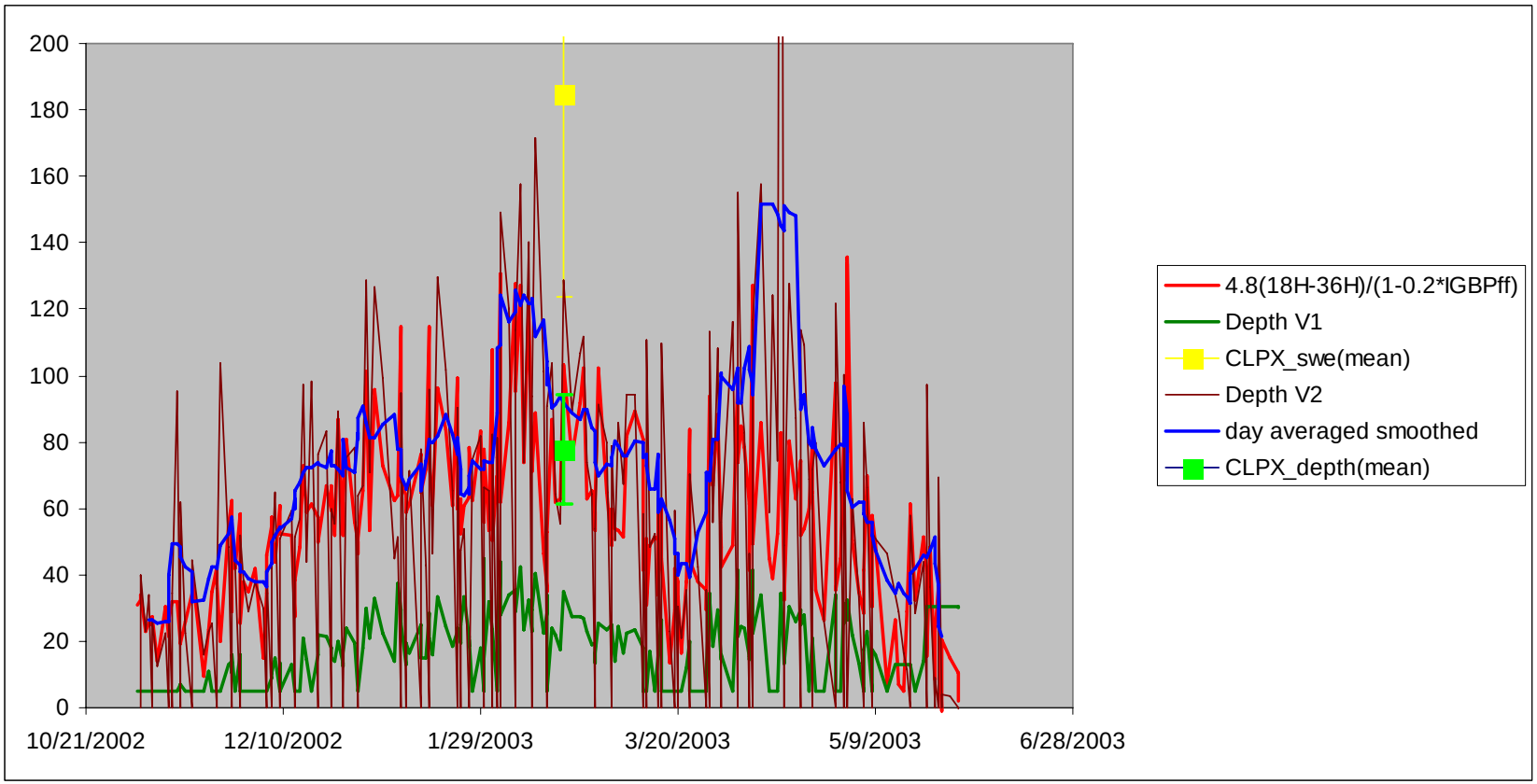
Fraser

Heavy forest fraction (IGBP>0.8) and forest density (VCF>0.5).

Herbaceous fraction 0.6.



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Conclusions & Plans

- The current AMSR-E algorithm takes advantage of higher spatial resolution MODIS vegetation representations of vegetation (the older approach needed an overhaul)
- There is a need to further improve the retrievals based on our evolving understanding of how snow-vegetation interactions moderate the passive microwave emission signal (several recent and current field experiments will help with this effort)
- There is even greater spatial resolution data available to update tree inventory information.
- Emission microwave models are one possible approach but they will require parameterization by ancillary data (e.g. species). The optical data will be useful here.

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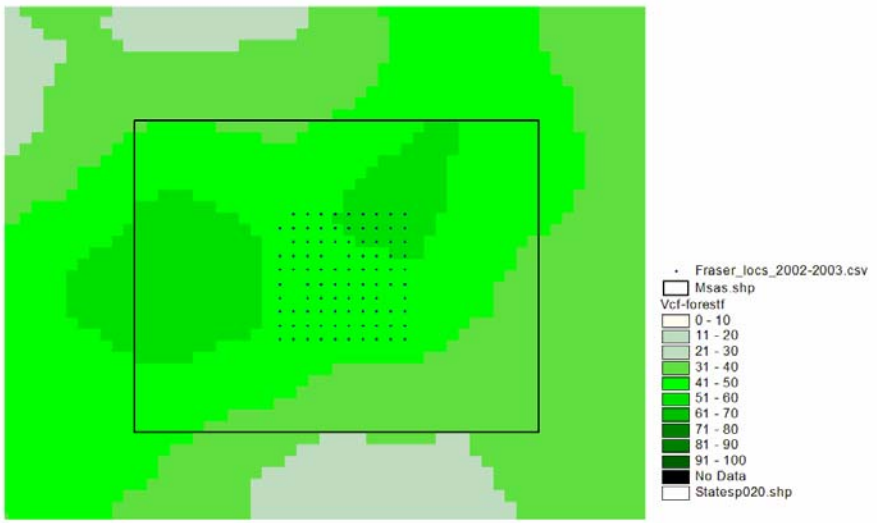
Fraser

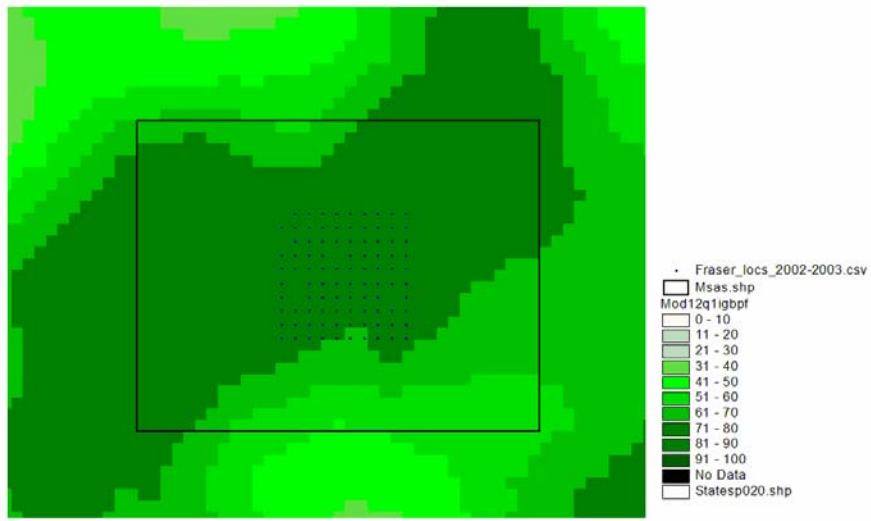
- AVHRR IGBP Forest Fraction (1992-1993) = 0.95
- DMSP OLS (1985) = 0.40

Average MODIS values:

MODIS VCF = 0.47



MODIS IGBP Cover = 0.77



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